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Indian Standard
SPECIFICATION FOR INDUCTIVE VOLTAGE DIVIDERS

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1989

Indian Standard

SPECIFICATION FOR INDUCTIVE VOLTAGE DIVIDERS

0. FOREWORD

0.1 This Indian Standard was adopted by the Bureau of Indian Standards on 1 September 1987, after the draft finalized by the Electrical Measuring Instruments Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 An inductive voltage divider (IVD) consists essentially of a tapped transformer (usually an auto-transformer) which produces a ratio of output voltage almost exactly equal to the ratio of the output turns to the input turns. In addition, the output impedance is low (typically a few ohms) and the input impedance is high (typically tens or hundreds of thousands of ohms). The stability of an IVD is substantially better than is implied by its accuracy class provided that it is not misused. These remarkable properties are achieved if the IVD is properly made; there is no need for subsequent accurate adjustments.

0.3 The performance of an IVD is characterized by the imperfection of its transfer ratio. The nominal transfer ratio (*see* **2.2.1**) which is the intended transfer ratio, usually given by the indication of the setting dials and by the trans ratio, differs from the true transfer ratio by this imperfection, which is called the transfer ratio error (*see* **2.4**).

0.4 While preparing this standard, assistance was derived from IEC Publication 618 Indicative voltage dividers, issued by the International Electrotechnical Commission.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard applies to inductive voltage dividers which are designed to provide a number of accurate ratios of alternating voltage over a range of frequencies and are intended to be used with negligible burden on their output.

1.2 In some multi-dial inductive voltage dividers, the setting circuit of the last (least significant) dial may be resistive.

1.3 This standard does not apply to transformer devices intended to supply a burden for measurement purposes which are covered by IS : 3156 (Part 2)-1978*.

1.4 This standard does not apply to any auxiliary equipment used with inductive voltage dividers.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions, in addition to those given in IS : 1885(Part 11)-1966† and IS : 1248 (Part 1)-1983‡, shall apply.

2.1 Inductive Voltage Divider (for Brevity, Referred to as IVD) — A device comprising one transformer or more than one interconnected transformers which, by means of switches or otherwise, can be set to provide output voltage equal to a selected proportion of the input voltage.

NOTE 1 — Such IVDs include devices which are referred to as 'precision autotransformers' 'decade transformer dividers', 'inductive dividers' and 'ratio transformers'.

NOTE 2 — Some IVDs have a separate auxiliary winding (the magnetizing winding) which supplies the magnetization and losses of the magnetic core. Use of this winding greatly increases the input impedance of the measuring winding and reduces the errors of the IVD. These IVDs are called '2-stage IVDs'.

2.2 Transfer Ratio — The ratio of the complex value representing the open circuit output voltage (phaser) of an IVD to the complex value representing its input voltage (phaser).

2.2.1 *Nominal Transfer Ratio* — The ratio between the open circuit output voltage and the input voltage indicated either by the setting(s) of the switch(es) or by some other method of selecting the ratio.

NOTE — This ratio is a pure number obtained by reading the instrument dials or similar indication.

2.3 Fiducial Value — A value to which reference is made in order to specify the accuracy of an

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*Specification for voltage transformers: Part 2 Measuring voltage transformers (*first revision*).

†Specification for Electrotechnical vocabulary : Part 11 Electrical measurements.

‡Specification for direct acting indicating analogue electrical measuring instruments and their accessories: Part 1 General requirements (*second revision*).

IVD. The fiducial value for an IVD is unity, that is, the ratio which corresponds (or which would correspond) to an open circuit output voltage equal to the input voltage.

2.4 Transfer Ratio Error — The value obtained by subtracing the true value of the transfer ratio from the value of the nominal transfer ratio.

NOTE 1 — When the transfer ratio error is expressed as a proportion of the fiducial value, its numerical value remains unchanged, as the fiducial value is a ratio of unity.

NOTE 2 — Although the transfer ratio error (e) is complex, containing both an in-phase (e_p) and a quadrature (e_q) component, for the purpose of this standard, only the modulus of this complex quantity is used.

The modulus of the transfer ratio error is expressed mathematically by:

$|e| \sqrt{e_p^2+e_q^2}$ (*see* 3.7)

NOTE 3 — The modulus of the transfer ratio error is expressed in percent, in parts per million (ppm) or in proportional parts using scientific notation of the fiducial value (*see* **4** and Table 1).

2.4.1 *Intrinsic Transfer Ratio Error* — Transfer ratio error determined under reference conditions.

2.5 Input Impedance

2.5.1 *Input Impedance of the Measuring Winding* — Under specified conditions, the impedance presented to the source by an IVD when its output terminals are open-circuited. For an IVD with a separate magnetizing winding ('2-stage'), this is the impedance at the measuring input terminals when the magnetizing winding is energized by a voltage of the same amplitude and phase as the voltage at the measuring input terminals.

NOTE 1 — The impedance of the magnetizing winding is not part of the input impedance of the measuring winding.

NOTE 2 — The use of magnetizing winding greatly increases the input impedance of the measuring winding.

2.5.2 *Input Impednace of the Magnetizing Winding* — Under specified conditions, the impedance presented to the source by the magnetizing winding of a 2-stage IVD, when the measuring winding is energized by a voltage having the same amplitude and phase as the voltage at the magnetizing winding terminals.

NOTE — The impedance of the measuring winding is not part of the input impedance of the magnetizing winding.

2.6 Output Impedance — Under specified conditions, the impedance presented to any load by an IVD when its input terminals are connected together by a link of negligible impedance.

NOTE — Output impedance is low (typically a few ohms).

2.6.1 *Maximum Output Resistance* — The highest value of the resistive component of the output impedance at any setting of the switch(es) or other ratio adjusting arrangement.

2.6.2 *Maximum Output Impedance* — The inductance which, at a particular frequency, produces the highest value of the reactive component of the output impedance any setting of the switch(es) or other ratio adjusting arrangement.

2.7 Influence Quantity — A quantity which is liable to cause unwanted variation in the transfer ratio of an IVD and affect its performance.

2.8 Variation — The difference between the true values of the transfer ratio when an influence quantity assumes successively two different specified values, all other influence quantities remaining within their reference conditions.

2.9 Reference Conditions — The specified conditions of influence quantities under which the IVD is intended to comply with the requirements concerning intrinsic transfer ratio errors. Each influence quantity may have either a reference value or reference range.

2.9.1 *Reference Value* — A specified single value of an influence quantity at which, within the stated tolerance, the IVD is intended to comply with the requirements concerning intrinsic transfer ratio errors.

2.9.2 *Reference Range* — A specified range of values which each influence quantity can assume without causing a variation exceeding the specified limits.

2.10 Nominal Range of Use — A specified range of values which each influence quantity can assume without causing a variation exceeding the specified limits.

2.11 Limiting Values of an Influence Quantity — Extreme values which an influence quantity may assume without the IVD being damaged or permanently altered in such a way that it no longer satisfies the requirements of its accuracy class.

2.12 Circuit Insulation Voltage (Nominal Circuit Voltage) — The highest voltage with respect to earth which may be applied to any circuit of an IVD so that the IVD is unlikely to become dangerous to touch.

2.13 Common Mode Voltage — Any voltage which exists between the common input-output terminal(s) and the earth terminal, the leakage current screen terminal or the electrostatic screen terminal (if any), separately or collectively (as specified).

NOTE — When the input and output circuits do not have a common point, the common mode voltage is defined between a specified terminal of each circuit and the earth terminal, or screen terminal or the electrostatic screen terminal (if any), according to the method of connection specified.

2.14 DC Series Mode Input Current — The value of the direct current which enters the input terminals.

2.15 Distortion Factor — The ratio of the rms value of the harmonic content to the rms value of the non-sinusoidal quantity.

2.16 Electrostatic Screen — An electrically conductive enclosure or coating intended to protect the enclosed space from external electrostatic influences.

2.17 Leakage Current Screen — A conductive path which prevents leakage currents to earth from affecting the results of measurements.

NOTE — The terminal of the leakage current screen is often called 'guard terminal'.

2.18 Resolution — The change of transfer ratio corresponding either to the smallest step or to the smallest division on the lowest (least significant) dial.

2.19 Auxiliary Equipment — Additional equipment, which is or is not an integral part of the IVD and is necessary to enable the IVD to operate accurately and safely as specified.

2.20 Accuracy — The accuracy of an IVD is defined by the limits of the modulus of intrinsic transfer ratio error and by the limits of variations of this modulus due to influence quantities (*see* **3.8**).

NOTE 1 — The accuracy is defined in terms of the modulus of the transfer ratio error which is a single descriptor representing in a practical way, the effective error of the IVD.

NOTE 2 — The accuracy of an IVD can also be stated, in part, by the in-phase component of its trnsfer ratio error. It is not defined in this way in this standard, and no requirements are given for it. However, when a certificate is provided, it is useful to give the in-phase error component which can be easily verified by the user.

2 20.1 *Accuracy Class* — A class of IVDs, the accuracy of all of which can be designated by the same number if they comply with the requirements of this standard.

2.20.2 *Class Index* — The number which designates the accuracy class.

3. TRANSFER RATIO AND OTHER PERFORMANCE CHARACTERISTICS

3.1 Transfer ratio (*see* **2.2**) is the principal characteristic of an IVD. In use, the transfer ratio is almost always less than unity. IVDs are rarely used as step-up devices where the errors are much larger.

3.2 For an IVD having nominal transfer ratios between 0 and 1, the modulus of the transfer ratio error is usually as shown in Fig. 1. Because this modulus is not proportional to the nominal transfer ratio, the permissible modulus of the transfer ratio error in this standard is the same for all nominal transfer ratios for a given accuracy class of IVD.

3.3 Figure 2 is a simplified circuit diagram of a single decade IVD to illustrate some connection problems. The points *X* and *Y* represent the points at which the wires to the input terminals *A* and *B* leave the transformer. Ideally the wires leading to the "1·0" and "0·0" terminals (or switch contacts) are connected to points *X* and *Y*. The voltage applied to the divider transformer is, therefore, slightly smaller than the input voltage due to the impedance of the connecting wires *AX* and *BY* and the current flowing in the winding producing a voltage drop and hence an error.

3.4 An additional possible source of error is the lack of certainty about the points between which the output voltage is measured. If the IVD is arranged as a 3-terminal device, the output is taken between *C* and *B*, and thus exceed the correct value by the voltage between *Y*

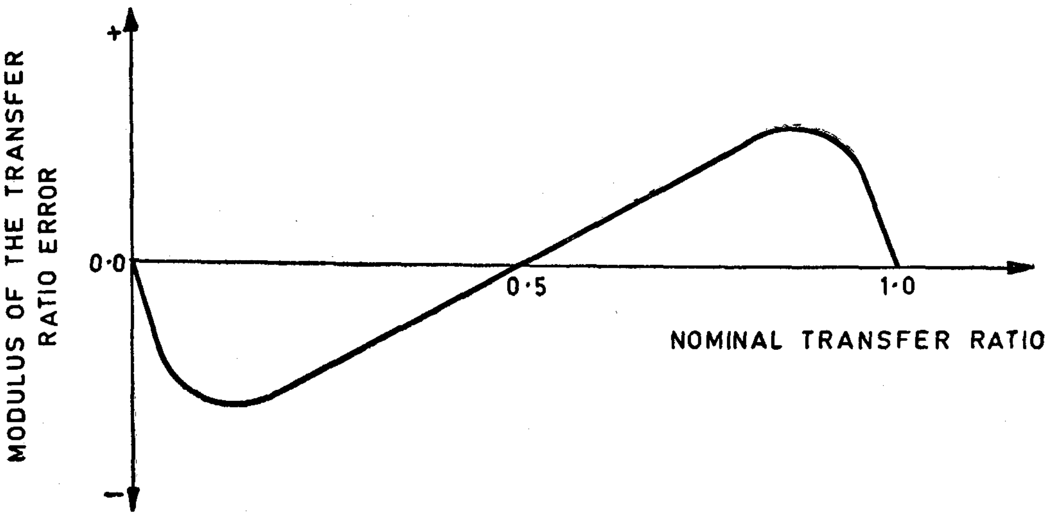

FIG. 1 TYPICAL ERRORS OF AN INDUCTIVE VOLTAGE DIVIDER

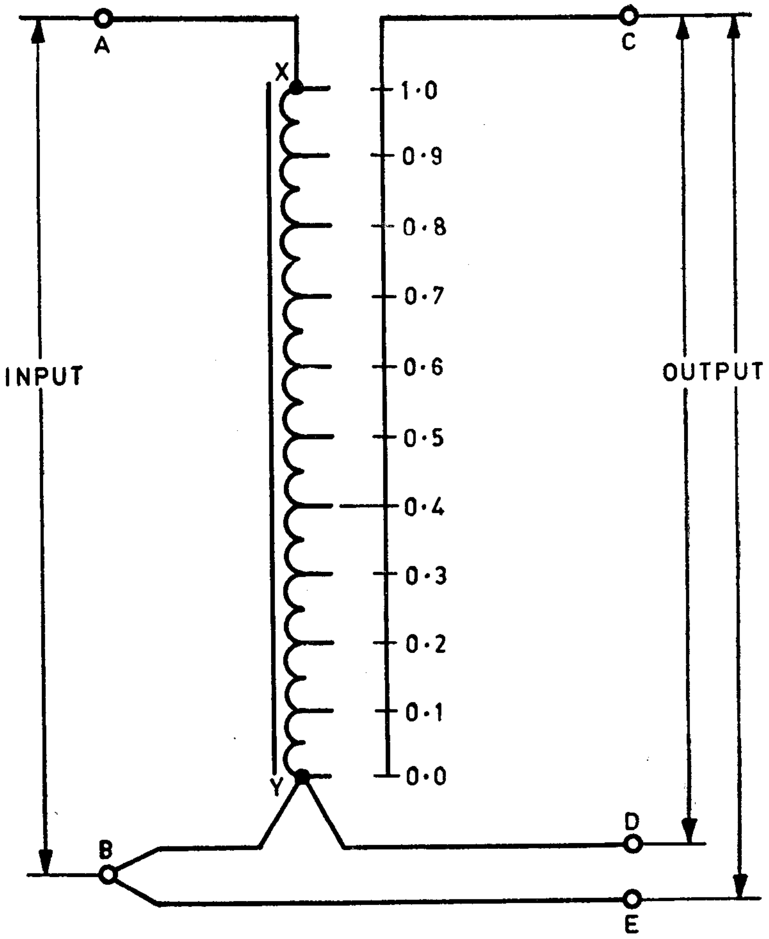

FIG. 2 INPUT AND OUTPUT CONNECTIONS OF AN INDUCTIVE VOLTAGE DIVIDER

and *B*. However, a 3-terminal IVD is sometimes provided with a fourth (output low) terminal *E*, connected by a link to the input low terminal *B*. In this case, the IVD functions as a 3-terminal device, although appearing to be a 4-terminal device.

3.5 If the IVD is arranged as a 4-terminal device, with the output low terminal *D* connected to *Y*, a nominal transfer ratio (setting) of 0·0 should produce zero output voltage. But, as explained in **3.3**, the voltage to be divided is slightly less than the input voltage.

3.6 In practice, the errors introduced by the facts mentioned in **3.3** to **3.5** are very small, and are even further reduced on a 2-stage IVD, which also has smaller errors due to other causes.

These remarks also apply to multi-decade IVDs though, due to switch contact resistance and loading effects, the errors are greater than for single-decade IVDs which are otherwise similar. The term 'decade' is here used for convenience; it does not imply only a device having ten equal steps.

3.7 Because of the parasitic impedances within the IVD, which are predominantly reactive, the open circuit output voltage is not exactly in phase with the input voltage. The transfer ratio error may, if required, be split into a pair of orthogonal components, the transfer ratio in-phase error and the transfer ratio quadrature error, being respectively the error components in phase with the input voltage and in quadrature with it (*see* **2.4**, Note 2).

3.8 The modulus and the phase defect of the transfer ratio error are, as a pair of terms, an alternative way of describing the transfer ratio error in place of the in-phase the quadrature pair of components.

The modulus and phase defect are often a more convenient way of describing IVD characteristics.

Because the phase defect is almost always very small, it is usually stated in microradians and is approximated by the transfer ratio quadrature error divided by the nominal transfer ratio.

The modulus of the transfer ratio error is almost exactly equal to the transfer ratio in-phase error and is often approximated by the letter.

3.9 An IVD has an output impedance which will modify the output voltage when the output is loaded. This impedance can usually be characterized by a small value of inductance in series with a resistance of a few ohms. The value of the output impedance depends on the nominal transfer ratio and on the frequency, so the manufacturer shall state the maximum output resistance and the maximum output inductance under reference conditions.

4. CLASSIFICATION

4.1 IVDs may be classified according to their accuracy classes as follows:

a) 0·0000001, 0·0000002, 0·0000005, 0·0000001, 0·1. — These values are expressed in percent of the fiducial value.

b) 0·001 ppm, 0·002 ppm, 0·005 ppm, 0·01 ppm, 1000 ppm — These values are expressed in parts per million (ppm of the fiducial value.

c) 1×10^{-9}, 2×10^{-9}, 5×10^{-9}, 1×10^{-8}, ..., 1×10^{-3} — These values are expressed by a single digit multiplied by an integral power of ten (commonly called scientific notation) as a proportion of the fiducial value.

The class index of an IVD can be given using any of these classification methods.

4.2 The full set of class indices is given in Table 1.

5. LIMITS OF INTRINSIC ERROR

5.1 Permissible Limits of Intrinsic Error — When an IVD is under the reference conditions given in Table 2, the modulus of the intrinsic transfer ratio error shall not exceed the values given in Table 1 relating to its class index.

5.2 Selectable Ratios — Unless otherwise specified, all selectable transfer ratios shall have the same accuracy class.

TABLE 1 LIMITS OF THE MODULUS OF THE INTRINSIC TRANSFER RATIO ERROR EXPRESSED AS A PROPORTION OF THE FIDUCIAL VALUE

(*Clause* 4.2)

CLASS INDEX			LIMIT OF THE MODULUS OF THE INTRINSIC TRANSFER RATIO ERROR		
Percent (1)	(ppm) (2)	Scientific Notation (3)	Percent (4)	(ppm) (5)	Scientific Notation (6)
0·000 000 1	0·001	1×10^{-9}	± 0·000 000 1	± 0·001	$\pm 1 \times 10^{-9}$
0·000 000 2	0·002	2×10^{-9}	± 0·000 000 2	± 0·002	$\pm 2 \times 10^{-9}$
0·000 000 5	0·005	5×10^{-9}	± 0·000 000 5	± 0·005	$\pm 5 \times 10^{-9}$
0·000 001	0.01	1×10^{-8}	± 0·000 001	± 0·01	$\pm 1 \times 10^{-3}$
0·000 002	0·02	2×10^{-8}	± 0·000 002	± 0·02	$\pm 2 \times 10^{-8}$
0·000 005	0·05	5×10^{-5}	± 0·000 005	± 0·05	$\pm 5 \times 10^{-8}$
0·000 01	0·1	1×10^{-7}	± 0·000 01	± 0·1	$\pm 1 \times 10^{-7}$
0·000 02	0·2	2×10^{-7}	± 0·000 02	± 0·2	$\pm 2 \times 10^{-7}$
0·000 05	0·5	5×10^{-7}	± 0·000 05	± 0·5	$\pm 5 \times 10^{-7}$
0·000 1	1	1×10^{-6}	± 0·000 1	± 1	$\pm 1 \times 10^{-6}$
0·000 2	2	2×10^{-6}	± 0·000 2	± 2	$\pm 2 \times 10^{-6}$
0·000 5	5	5×10^{-6}	± 0·000 5	± 5	$\pm 5 \times 10^{-6}$
0·001	10	1×10^{-5}	± 0·001	± 10	$\pm 1 \times 10^{-5}$
0·002	20	2×10^{-5}	± 0·002	± 20	$\pm 2 \times 10^{-5}$
0·005	50	5×10^{-5}	± 0·005	± 50	$\pm 5 \times 10^{-5}$
0·01	100	1×10^{-4}	± 0·01	± 100	$\pm 1 \times 10^{-4}$
0·02	200	2×10^{-4}	± 0·02	± 200	$\pm 2 \times 10^{-4}$
0·05	500	5×10^{-4}	± 0·05	± 500	$\pm 5 \times 10^{-4}$
0·1	1 000	1×10^{-3}	± 0·1	± 1 000	$\pm 1 \times 10^{-3}$

TABLE 2 REFERENCE CONDITIONS AND TOLERANCES OF THE INFLUENCE QUANTITIES

(*Clauses* 5.1 *and* 6.1)

INFLUENCE QUANTITY (1)	REFERENCE CONDITIONS UNLESS OTHERWISE STATED BY THE MANUFACTURER (2)	TOLERANCES PERMITTED FOR TESTING PURPOSES (*See* Note 1) (3)
Ambient temperature	Value to be marked (*see* Note 2)	Reference temperature ± 10°C
Relative humidity	10 to 60 percent	—
Position	Any	—
Input voltage	Reference voltage (*see* Note 3)	± 5 percent
AC common mode voltage	Zero	1 percent of input voltage
Frequency	Refrence frequency (*see* Note 3)	± 2 percent
DC series mode input current (*see* Note 4)	Zero	100 nA
Externally produced magnetic field	Total absence	Value of terrestrial magnetic field strength
Input voltage distortion factor	Zero	1 percent

NOTE 1 — For a reference range, no tolerance is allowed.

NOTE 2 — Should be selected from 20, 25 or 27°C.

NOTE 3 — To be stated by the manufacturer.

NOTE 4 —This also applies to direct current which enters the output terminals.

5.3 Stability of Transfer Ratio — For IVDs, stability of transfer ratio with regard to time is an essential characteristic. IVDs shall comply with the limits of intrinsic transfer ratio error specified for their respective classes for a duration of one year from the date of certification associated with delivery or another date to be agreed upon by the manufacturer or responsible supplier and the user, provided that the conditions of use, transport and storage specified by the manufacturer are complied with.

NOTE — Here, it is specified only for the duration of one year, but experience has shown that the ratios are essentially independent of time. However, the ratios may be altered by extreme physical abuse, by core saturation resulting from high-level input switching, by magnetizaion of the core due to direct current flowing through the IVD or by the occurrence of high-contact resistance in switches.

6. CONDITIONS FOR THE DETERMINATION OF INTRINSIC ERRORS

6.1 The reference conditions relative to each of the influence quantities are shown in Table 2.

6.2 Before any measurement, sufficient time shall be given for the IVD to reach a stable state and to be in equilibrium with the reference value of the influence quantities.

6.3 If relevant, the necessary duration of application of the input voltage prior to the measurement shall be stated by the manufacturer. In the absence of any such statement, this duration shall be zero but subject to the requirements specified in **8.2**.

6.4 The leakage current screen, if any, shall be used in accordance with the manufacturer's instructions.

The electrostatic screen, if any and separate from the leakage current screen, shall be connected to earth.

The enclosure, if conductive, shall be connected to earth.

6.5 Any other conditions which are also necessary shall be stated by the manufacturer.

7. PERMISSIBLE VARIATIONS

7.1 Limits of Variations — When the IVD is under the reference conditions given in Table 2 and a single influence quantity is varied in accordance with **7.2**, the variation shall not exceed the values specified in Table 3.

7.2 Conditions for the Determination of the Variations

7.2.1 Variations shall be determined for each influence quantity. During each determination, all other influence quantities shall be maintained at their reference conditions.

7.2.2 The variation is assessed as given in **7.2.2.1** and **7.2.2.2**.

7.2.2.1 When a reference value is assigned to an influence quantity, it shall be varied between that value and any value within the limits of the nominal range of use as given in Table 3.

TABLE 3 LIMITS OF THE NOMINAL RANGE OF USE AND PERMISSIBLE VARIATION

(*Clause* 7.1)

INFLUENCE QUANTITY	LIMITS OF THE NOMINAL RANGE OF USE UNLESS OTHERWISE STATED BY THE MANUFACTURER	PERMISSIBLE VARIATION EXPRESSED AS A PERCENTAGE OF THE CLASS INDEX
(1)	(2)	(3)
Ambient temperature	Reference temperature ± 15°C	20
Relative humidity	10 and 75 percent	30
Input voltage	5 and 100 percent of the voltage U_r or U_c whichever is smaller (*see* 8.1)	50
AC Common mode input current	0 and 100 percent of input voltage	50
Frequency	Range to be stated by the manufacturer	100
DC series mode input current	0 and maximum value as stated by the manufacturer	50
Externally produced magnetic field	0 and maximum value as stated by the manufacturer	50
Input voltage distortion factor	5 percent	10

7.2.2.2 When a reference range and a nominal range of use are assigned to an influence quantity, it shall be varied between each of the limits of the reference range and any value in that part of the nominal range of use adjacent to the chosen limit of the reference range.

7.2.3 Wider combinations of voltage and frequency associated with other accuracy classes may be stated by the manufacturer.

7.3 Variation Due to dc Series Mode Current — If required by the purchaser, tests to determine the effect of a dc series mode current are only to be carried out by agreement between the manufacturer and the purchaser.

7.4 Variation Due to the Influence of an Externally Produced Magnetic Field — The variation shall not exceed the limit specified by the manufacturer (*see* Table 3) when determined within the nominal range of use specified by the manufacturer (*see* Table 3).

The test apparatus may be as in **4.5** of IS : 1248 (Part 9)-1983* or as agreed between the manufacturer and the purchaser, other devices may be used which produce an adequate homogeneous magnetic field in the absence of the IVD under test. The current in the coil shall be, in sequence, direct current in each direction and alternating current at the reference frequency. In the later case, the phase relationship between the current in the coil and the IVD input volage shall be changed through a full range of 360°.

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*Specification for direct acting indicating analogue electrical measuring instruments and their accessories: Part 9 Test methods (*second revision*).

8. ADDITIONAL ELECTRICAL AND MECHANICAL REQUIREMENTS

8.1 Limiting Values of Input Voltage — The value of the permissible input voltage is given in two parts, neither of which shall be exceeded:

a) A maximum rms value U_c, to be stated by the manufacturer,

b) A value proportional to frequency, dominant at lower frequencies, given by the expression:

$$U_f = k \times f$$

where

U_f = rms value in volts,

k = constant to be stated by the manufacturer, and

f = frequency in hertz.

8.2 Input Voltage Switching

8.2.1 IVDs of accuracy classes 1×10^{-6}, . . ., 1×10^{-3} (0·000 1, . . ., 0·1) (1 ppm, . . ., 1 000 ppm) shall be capable of withstanding, without deterioration in accuracy, the sudden application or to removal from their inputs of half the value of the permissible input voltage at any point on the input supply waveform.

8.2.2 For IVDs of accuracy classes 1×10^{-9}, . . ., 5×10^{-7} (0·000 000 1, . . ., 0·000 05) (0·001 ppm, . . ., 0·5 ppm), the manufacturer may state a lower fraction than half the value of the permissible input voltage. In the absence of such a statement, the fraction shall be as given in **8.2.1.**

8.3 Voltage Test and Other Safety Requirements — The provisions of **6.1** of IS : 1248 (Part 1)-1983* shall apply.

8.4 Insulation Resistance Test — The value of dc insulation resistance measured at 500 V ± 10 percent or at the circuit insulation voltage (nominal circuit voltage) ± 10 percent, whichever is greater, between any two points which are not intended to have any connection between them, shall be not less than 1×10^9 ohms.

The measurement shall be made between 1 and 2 min after the application of the voltage.

8.5 Limiting Conditions for Storage, Transport and Use — Unless otherwise stated by the manufacturer, IVDs shall be capable of withstanding exposure to ambient temperatures within the range −10 to +50°C without damage. After returning to reference conditions, IVDs shall meet the requirements of this standard.

The manufacturer shall specify any additional limiting conditions required to ensure the integrity of the IVD.

9. INFORMATION, MARKINGS AND SYMBOLS

9.1 Information

9.1.1 The following information shall be given by the manufacturer:

1) Manufacturer's name or trade mark or that of the responsible supplier;
2) Type reference given by the manufacturer or responsible supplier;
3) Serial number, when agreed between the manufacturer and user; the serial number may be omitted for IVDs of accuracy classes 1×10^{-6}, . . ., 1×10^{-3} (0·0001. . . ., 0·1) (1 ppm, ..., 1 000 ppm);
4) Class index;
5) Range of nominal transfer ratios;
6) Resolution;
7) Reference temperature;
8) Nominal range of use for temperature, if different from that given in Table 3;
9) Limiting values of input voltage;
10) Reference voltage;
11) Reference value for range of frequency;
12) Nominal range of use for frequency;
13) Test voltage;
14) Value of U_c [*see* **8.1** (*a*)];
15) Value of *k* given in volts per hertz [*see* **8.1** (*b*)];
16) Value of the permissible switching voltage (*see* **8.2.2**);
17) Where relevant, reference position and nominal range of use for position;
18) Where relevant, essential parameteres of the auxiliary equipment;
19) Circuit diagram, values of components and list of replaceable parts;
20) Input impedance of the measuring winding under reference condition;
21) Input impedance of the magnetizing winding (if any) under reference condition;
22) Maximum output resistance and maximum output inductance under reference conditions;
23) Maximum value of dc series mode input current;
24) Maximum value of externally produced magnetic field;
25) Reference value (range) and nominal range of use for other influence quantities if different from those given in Tables 2 and 3; and
26) Required duration of application of the input voltage prior to measurement, if not zero.

9.1.2 If a certificate is supplied by agreemenr between the manufacturer or responsible suppliet and the user, it shall contain the following information:

a) Certified value(s) of transfer ratio(s) together with their uncertainties,

b) Date of certification, and

c) Designation of certifying authority.

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*Specification for direct indicating analogue electrical measuring instruments and their accessories: Part 1 General requirements and tests (*second revision*).

9.2 Markings, Symbols and Their Locations

9.2.1 The markings and symbols shall be legible and indelible.

SI units, together with their prefixes, shall be marked using the symbols given in Appendix A of SI : 1248 (Part 1)-1983*.

The symbols specified in Table 4 shall be used where relevant.

TABLE 4 SYMBOLS FOR MARKING INDUCTIVE VOLTAGE DIVIDERS

No.	Item	Symbol
D	Position of use	*See* Appendix A of IS : 1248 (Part 1)-1983*
D-1	IVD to be used with the supporting surface vertical	
D-2	IVD to be used with the supporting surface horizontal	
D-3	IVD to be used with the supporting surface inclined (for example, 60°) from the horizontal plane	
D-4	Example for IVD to be as D-1 Nominal range of use 80°, ..., 100°	
D-5	Example for IVD to be used as D-2 Nominal range of use −1°, ..., +1°	
D-6	Example for the IVD to be used as D-3 Nominal range of use 45, ..., 75°	
E-1	Class index (for example, 0·01) with errors expressed as a percentage of the fiducial value	0·1
E-5	Class index (for example, 1×10^{-4}) with erros expressed as a proportion of the fiducial value using scientific notation	1×10^{-4}
E-6	Class index (for example, 100 ppm) with errors expressed in parts per million of the fiducial value	100 ppm
F	General symbols	
F-27	Electrostatic screening	*See* Appendix A of IS : 1248 (Part 1)-1983*
F-31	Earth terminal	
F-33	Refer to a separate document	

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9.2.2 The following information shall be marked on a nameplate or on the case (*see* **9.1.1**):

1) Manufacturer's name or trade-mark or that of the responsible supplier;
2) Type reference given by the manufacturer or responsible supplier;
3) Serial number; when agreed between the manufacturer and user, the serial number may be omitted for IVDs of accuracy classes 1×10^{-6}, . . ., 1×10^{-3} (0·0001, . . ., 0·1) (1 ppm, . . ., 1 000 ppm);
4) Class index using symbols E-1 E-5, or E-6;
5) Reference temperature;
6) Nominal range of use for temperature, if different from that given in Table 3;
7) Limiting values of input voltage;
8) Reference voltage;
9) Reference value for range of frequency;
10) Test voltage using symbols C-1 to C-3;
11) Value of U_c;
12) Value of K; and
13) Reference position using symbols D-1 to D-6.

In addition, the following markings and symbols shall be made:

a) 'Inductive voltage divider' or this term in another language;
b) where relevant, symbol F-33 showing that some other essential information is given in a separate document; and
c) If a reference value or a reference range is marked, it shall be identified by underlining.

9.2.3 Each terminal shall be marked to show its function.

9.2.4 Additional information may be given on a nameplate, or on the case or in a separate document.

9.3 Documentation

9.3.1 Documentation shall state:

a) method of putting into operation;
b) procedures for establishing compliance with the performance requirements of this standard; and
c) recommended routine maintenance, if relevant.

9.3.2 Documentation shall also state relevant information as stated in **9.1.1**.

9.3.3 The certificate referred to in **9.1.1**, when supplied, shall state information as given in **9.1.2**.

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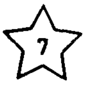
9.4 Example of the marking of an IVD

Inductive Voltage Divider

N.N. Type A.B.C.D.
No. 12345
1×10^{-5}
0·2 V/HZ *200 V* 300 V
10 Hz...*1kHz*...10 kHz
10...*20*...*25*...45°C

$\overline{80...\mathit{90}...100°}$



The above markings give the following information:

a) IVD, type A.B.C.D., serial number 12345, manufactured by N.N.;

b) The class index is 1×10^{-5} (0·001 or ppm may be marked instead);

c) The value of the constant k is 0·2 V/Hz;

d) The reference voltage is 200 V;

e) The maximum value of the input voltage (U_c) is 300 V;

f) The reference frequency is 1 kHz and the nominal range of use for frequency is from 10 Hz to 10 kHz;

g) The reference range for temperature is from 20 to 27°C and the nominal range of use for temperature is from 10 to 45°C, (These values are shown because they are different from those given in Tables 2 and 3);

h) The position symbol (symbol D-4) indicates that the reference position is with the supporting surface vertical with a nominal range of use of 10° around the vertical; and

j) The IVD has withstood a voltage test of 7 kV based on the circuit insulation voltage (nominal circuit voltage) of 3 kV.

The majority of these symbols have been taken from IS : 1248(Part 1)-1983*.

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